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(चौथा पुनरीक्षण)

Foam Concentrate for
Producing Mechanical Foam
for Fire Fighting — Specification
(*Fourth Revision*)

ICS 13.220.10; 71.080

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FOREWORD

This Indian Standard (Fourth Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Fire Fighting Sectional Committee had been approved by the Civil Engineering Division Council.

Foam is a homogeneous mass of tiny air or gas filled in bubbles of low specific gravity which when applied in correct manner and in sufficient quantity, form a compact fluid and stable blanket which is capable of floating on the surface of flammable liquids and preventing emission of flammable vapours. It is produced by mechanically mixing a gas or air to a solution of a foam compound (concentrate) in water. This standard covers the foam compound in the form of a homogeneous liquid, free from suspended and visible impurities used for the production of fire fighting foam which is produced by mechanical aeration of water foam concentrate solution.

The foam produced from the concentrates in this standard are of low expansion (up to 20 times). The low expansion foam concentrates are of the following types:

- a) *Protein foam (PF)* — A foam concentrate that has a hydrolyzed protein base with stabilizing additives suitable for Class A and Class B fires (only non-polar).
- b) *Aqueous film forming foam (AFFF)* — A foam concentrate that has a fluorinated surfactant with stabilizing additive and synthetic surfactants foaming agents for Class A and Class B fires (only non-polar).
- c) *Fluoro-protein film forming foam (FFFP)* — A foam concentrate that has protein base with one or more fluorinated surfactant additives for Class A and Class B fires (only non-polar).
- d) *Fluoroprotein foam concentrate (FP)* — A foam concentrate that has protein base with one or more fluorinated surfactant additives for Class A and Class B fires (only non-polar).
- e) *Alcohol resistance aqueous film forming foam (AR AFFF)* — A foam concentrate that has a fluorinated surfactant with stabilizing additive of polysaccharide and synthetic surfactants foaming agents for Class A and Class B fires (both polar and non polar).
- f) *Alcohol resistant fluoroprotein foam (ARFP)* — A foam concentrate that has protein base with one or more fluorinated surfactant with stabilizing additive of polysaccharide for Class A and Class B fires (both polar and non-polar).
- g) *Alcohol resistant film forming fluoroprotein foam (ARFFFP)* — A foam concentrate that has protein base with one or more fluorinated surfactant with stabilizing additive of polysaccharide for Class A and Class B fires (both polar and non-polar).
- h) *Synthetic foam (SF)* — A non-fluoro surfactant base concentrate non-hydrolyzed protein suitable only for Class A fire. It can be used as low, medium and high expansion depending on the application of foam equipment.

This standard covering only protein foam concentrate was first published in 1969 and revised in 1974. Subsequently, it was decided to revise it in parts. As a result, Part 1 covering protein foam concentrate, Part 2 covering aqueous film forming foam and Part 3 covering fluoro-protein foam were brought out in 1985, 1984 and 1987, respectively. Part 4 of this standard covering multipurpose aqueous film forming foam liquid concentrate for extinguishing hydrocarbon and polar solvent fires was published in 2003.

The third revision of this standard was brought out in 2006 by amalgamating first three parts of IS 4989 namely:

- a) Part 1 Protein foam concentrate,
- b) Part 2 Aqueous film forming foam, and
- c) Part 3 Fluoro-protein foam.

However, Part 4 was retained as a separate standard.

Now in this fourth revision, IS 4989 (Part 4) has also been amalgamated in this standard. While taking up this revision, guidance has been taken from ISO 7203-1 : 2011 'Fire extinguishing media — Foam concentrates — Part 1: Specification for low-expansion foam concentrates for top application to water-immiscible liquids' and ISO 7203-3 : 2011 'Fire extinguishing media — Foam concentrates — Part 3: Specification for low-expansion

(Continued on third cover)

Indian Standard

FOAM CONCENTRATE FOR PRODUCING MECHANICAL FOAM FOR FIRE FIGHTING — SPECIFICATION

(Fourth Revision)

1 SCOPE

This standard lays down requirement in respect of physical and chemical properties and performance over fires of standard fuel, for which these foams are formulated. This standard also lays down requirement for packaging and storage.

2 REFERENCES

The standards listed below contain provisions which through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standards indicated below:

IS No.	Title
5 : 2007	Colours for ready mixed paints and enamels (<i>sixth revision</i>)
554 : 1999	Pipe threads where pressure-tight joints are made on threads — Dimensions, tolerances and designation (<i>fourth revision</i>)
1206 (Part 3) : 1978	Method for testing tar and bitumen materials: Determination of viscosity: Part 3 Kinematic viscosity
1783	Drums, large, fixed ends — Specification
(Part 1) : 2014	Grade A drums
(Part 2) : 2014	Grade B drums
2552 : 1989	Steel drums (galvanized and ungalvanized) (<i>third revision</i>)
2932 (Part 1) : 2013	Enamel, synthetic, exterior: (a) Undercoating (b) Finishing — Specification: Part 1 For domestic and decorative applications
4309 : 1979	Method of measurement on direct reading pH meters (<i>first revision</i>)
4905 : 2015 / ISO 24153 : 2009	Random sampling and randomization procedures (<i>first revision</i>)

IS No.

Title

7959 : 1987	Specification for polyethylene containers for foam compounds (<i>first revision</i>)
13607 : 1992	Ready mixed paint, finishing, general purposes, synthetic — Specification

3 CLASSIFICATION

3.1 The foam concentrate covered in this standard shall be of the following types:

- a) *AFFF, Type 1 (AFFF-1 percent)* — To be used with 99 percent water and 1 percent concentrate.
- b) *AFFF, Type 3 (AFFF-3 percent)* — To be used with 97 percent water and 3 percent concentrates.
- c) *AFFF, Type 6 (AFFF-6 percent)* — To be used with 94 percent water and 6 percent concentrates.
- d) *PF, Type 3 (PF-3 percent)* — To be used with 97 percent water and 3 percent concentrates.
- e) *PF, Type 6 (PF-6 percent)* — To be used with 94 percent water and 6 percent concentrates.
- f) *FP, Type 3 (FP-3 percent)* — To be used with 97 percent water and 3 percent concentrates.
- g) *FP, Type 6 (FP-6 percent)* — To be used with 94 percent water and 6 percent concentrates.
- h) *FFFP, Type 3 (FFFP-3 percent)* — To be used with 97 percent water and 3 percent concentrates.
- j) *FFFP, Type 6 (FFFP-6 percent)* — To be used with 94 percent water and 6 percent concentrates.
- k) *AR AFFF, Type 3/3 (AR AFFF-3/3 percent)* — To be used with 97 percent water and 3 percent concentrates for both polar and non polar liquids.
- m) *AR AFFF, Type 3/6 (AR AFFF-3/6 percent)* — To be used with 97 percent water and 3 percent concentrates for non-polar liquids and to be used with 94 percent water and 6 percent concentrates for polar liquids.
- n) *AR FFFP, Type 3/3 (AR FFFP-3/3 percent)* — To be used with 97 percent water and 3 percent concentrates for both polar and non-polar liquids.
- p) *AR FFFP, Type 3/6 (AR FFFP-3/6 percent)* — To be used with 97 percent water and 3 percent

concentrates for non-polar liquids and to be used with 94 percent water and 6 percent concentrates for polar liquids.

- q) AR FP, Type 3/3 (*AR FP-3/3 percent*) — To be used with 97 percent water and 3 percent concentrates for both polar and non-polar liquids.
- r) AR FP, Type 3/6 (*AR FP-3/6 percent*) — To be used with 97 percent water and 3 percent concentrates for non polar liquids and to be used with 94 percent water and 6 percent concentrates for polar liquids.
- s) SF, Type 1 (*SF-1 percent*) — To be used with 99 percent water and 1 percent concentrates.
- t) SF, Type 3 (*SF -3 percent*) — To be used with 97 percent water and 3 percent concentrates.
- u) SF, Type 6 (*SF-6 percent*) — To be used with 94 percent water and 6 percent concentrates.

3.2 All the above types of foam concentrates are suitable only for top application. A special requirement can be put separately by users for base injection system for oil storage tanks.

4 REQUIREMENTS

4.1 General

Protein base foam, fluoroprotein foam and film forming fluoroprotein foam, etc., are dark brown or reddish brown colour liquid with some offensive odour. The AFFF and synthetic (Class A) foams are clear liquids with no offensive odour.

4.2 Characteristics

The foam concentrate shall conform to physical and chemical requirements given in Table 1 and fire performance requirements given in Table 2, when tested in accordance with method specified against each.

NOTES

1 Fire tests for both polar and non-polar liquids are more expensive and time consuming than the other tests of this standard. It is recommended that they are carried out at the end of the test programme, so as to avoid the expense of unnecessary testing of foam concentrates which do not comply with other requirements of this standard.

2 Method of generating foam shall be as per Annex H.

5 PACKING

5.1 Foam concentrate shall be packed in high density polyethylene (HDPE) containers conforming to IS 7959, or suitable polyethylene container of specification as agreed to between the purchaser and the supplier.

5.2 In addition to polyethylene containers specified in 5.1, ungalvanized mild steel drums/barrels may also be used for PF, FP and FFFP. The ungalvanized mild steel drum of 20 litre capacity shall conform to Grade

A2 or B2 of IS 2552. The ungalvanized mild steel barrel of 200 litre capacity shall conform to IS 1783 (Part 1) or IS 1783 (Part 2). The closure of drum and barrel shall be 75 or 100 mm. The internal surface may be left in natural finish and free from rust. The external surface of drums and barrels shall be painted with suitable primer (*see* IS 13607) and then painted fire red or post office red conforming to shade No. 536 or 538 of IS 5. The paint shall conform to IS 2932 (Part 1).

6 STORAGE

6.1 The storage place shall be free from dampness and shall be well ventilated and the container shall not be directly exposed to the sun rays.

6.2 The polyethylene containers shall be preferably stacked in single layers and shall not exceed more than 2 layers.

6.3 For bulk storage, the recommended storage container should be made of stainless steel (SS 304) or as per foam manufacturer's recommendation.

6.4 Range of storage temperature shall be 0°C to 50°C for prolonged storage.

6.5 The recommended shelf life of different foam concentrates, if stored as specified in 6.1 to 6.4, are as follows:

- a) For AFFF, AR AFFF and SF is 10 years; and
- b) For PF, FP, FFFP, AR FP and AR FFFP is 5 years.

However, pH, sludge content, surface tension, spreading coefficient expansion and drainage time should be checked every two years and fire test every 3 years interval.

7 MARKING

7.1 Each container shall be legibly and indelibly marked with the following information:

- a) Manufacturer's name and trade-mark, if any;
- b) To be written, as applicable:
 - 1) PF : For protein foam concentrate for fire fighting
 - 2) FP : For fluoro-protein foam concentrate for fire fighting
 - 3) FFFP : For film forming fluoro-protein foam concentrate for fire fighting
 - 4) AR FP : For alcohol resistant fluoro protein
 - 5) AR FFFP : For alcohol resistant film forming fluoro protein
 - 6) AFFF : For aqueous film forming foam for fire fighting

- 7) AR AFFF : For alcohol resistant aqueous film forming foam for fire fighting
- 8) SF : For synthetic foam class A for fire fighting

NOTE — Add type 1/type 3/type 6/type 3/3 and type 3/6 as applicable;

- c) Foam compatible with sea water;
- d) Quantity, in litres;
- e) Month and year of manufacture and production batch number;
- f) Net and gross mass, in kg;
- g) Do not store in direct sunrays;
- h) 'Freeze protected foam, usable temperature up to — °C', if applicable; and
- j) Name and percentage of fluorocarbon surfactant used.

7.2 BIS Certification Marking

The container may also be marked with the Standard Mark.

7.2.1 The use of Standard Mark is governed by the provisions of *Bureau of Indian Standards Act, 2016* and the Rules and Regulations made thereunder. The details of the conditions under which the licence for use of the Standard Mark may be granted to manufacturers or producers may be obtained from Bureau of Indian Standards.

8 FUEL FOR FIRE PERFORMANCE TESTING

8.1 Hydrocarbon Fire (Non-Polar Liquid)

Fuel shall be *n*-heptane and its certain mixture called commercial heptane with the following specification

shall be used:

- a) Distillation range, 84°C to 105°C.
- b) Maximum difference between initial and final boiling point shall not exceed 10°C.
- c) Density/specific gravity, 0.65 to 0.75 at $27 \pm 5^\circ\text{C}$.

8.2 Polar Solvent Fire

Fuel shall be commercial grade of iso-propyl alcohol having 98 percent of purity.

9 TYPE TEST

Fire performance test shall be considered as type test.

10 SAMPLING OF THE FOAM CONCENTRATE FROM BULK STORAGE

10.1 The number of filled containers to be sampled from each batch for ascertaining conformity shall be in accordance with following table:

<i>Total Number of Filled Containers from Each Batch</i>	<i>Number of Containers to be Selected</i>
Up to 100	5
101 to 200	10
201 and above	15

10.2 The containers shall be selected at random from each batch. To ensure the randomness of selection, method given in IS 4905, may be adopted. The equal amount of samples collected from each selected container should be mixed to make a composite sample to carry out the single conformity test.

Table 1 Type of Foam Concentrate — Physical and Chemical Requirements
(Clause 4.2)

Sl No.	Test Parameters ↓ TYPE →	AFFF	PF	FP	FFFP	SF	AR-AFFF	AR-FFFP	AR-FP	Test Method, Ref to Annex
(1)	(2)	1, 3 and 6 (3)	3 and 6 (4)	3 and 6 (5)	3 and 6 (6)	1, 3 and 6 (7)	3/3 and 3/6 (8)	3/3 and 3/6 (9)	3/3 and 3/6 (10)	(11)
i)	Visual examination	←—————→			shall not show any sedimentation or stratification				—————→	A-1
ii)	Freezing and thawing	←—————→			shall not show any sedimentation or stratification				—————→	A-2
iii)	pH both original and ageing	7.5 ± 1.0	7.0 ± 1.0	7.0 ± 1.0	7.0 ± 1.0	7.0 ± 1.0	7.5 ± 1.0	7.0 ± 1.0	7.0 ± 1.0	Annex B
iv)	Specific gravity both original and ageing	1.00, <i>Min</i>	1.08, <i>Min</i>	1.08, <i>Min</i>	1.08, <i>Min</i>	1.00, <i>Min</i>	1.00 ± 10%	1.10 ± 10%	1.10 ± 10%	Annex C
v)	Miscibility with distilled water	Miscible	Miscible	Miscible	Miscible	Miscible	—	—	—	Annex D
vi)	Viscosity, <i>Max</i>	20 cst	20 cst	20 cst	20 cst	20 cst	To be declared by manufacturer.	To be declared by manufacturer.	To be declared by manufacturer.	Using viscosity meter, see SI No. (iv) of Table 2 of IS 1206 (Part 3)
vii)	Pour point ¹⁾	←—————→			Freely move at 0 °C or below				—————→	Annex E
viii)	Sludge content, <i>Max</i>	0.25 percent (origin) 0.50 percent (ageing)	0.5 percent (origin) 1 percent (ageing)	0.5 percent (origin) 1 percent (ageing)	0.5 percent (origin) 1 percent (ageing)	0.25 percent (origin) 0.50 percent (ageing)	—	—	—	Annex F
ix)	Surface tension (dynes/cm), <i>Max</i>	18.00	—	—	18.00	—	18.00	18.00	—	Annex G
x)	Spreading coefficient (dynes/cm), <i>Min</i>	3.00	—	—	(+)VE	—	3.00	(+)VE	—	Annex G

¹⁾ Manufacturer should declare the pour point in case of below 0 °C.

Table 2 Type of Foam Concentrate —FirePerformance Requirement
(Clause 4.2)

SI No.	Test Parameters ↓ TYPE →	AFFF	PF	FP	FFFP	SF	AR-AFFF	AR-FFFP	AR-FP	Test Method, Ref to Annex
(1)	(2)	1, 3 and 6 (3)	3 and 6 (4)	3 and 6 (5)	3 and 6 (6)	1, 3 and 6 (7)	3/3 and 3/6 (8)	3/3 and 3/6 (9)	3/3 and 3/6 (10)	(11)
i)	Expansion at 27±5°C	6.00 to 10.00	6.00 to 10.00	6.00 to 10.00	6.00 to 10.00	6, <i>Min</i>	6.00 to 10.00	6.00 to 10.00	6.00 to 10.00	Annex J
ii)	25 percent drainage time at 27±5°C, <i>Min</i>	90 s	150 s	120 s	120 s	90 s	180 s	180 s	180 s	J
iii)	Fire test on hydrocarbon fires (non-polar)									
	a) Fire control time ¹⁾ , <i>Max</i>	2 min	3 min	3 min	2 min	—	2 min	2 min	2 min	K
	b) Fire extinction time ²⁾ , <i>Max</i>	3 min	5min	4 min	4 min	—	3 min	3 min	4 min	K
	(Total foam discharge / application time)									
	c) Seal ability/Film forming	To pass the test	To pass the test	To pass the test	To pass the test	—	To pass the test	To pass the test	To pass the test	K
	d) Burn back, <i>Min</i>	5 min	8 min	8 min	8 min	—	5 min	5 min	5 min	K
iv)	Fire test on polar solvent fires:									
	a) Fire control time ¹⁾ , <i>Max</i>	—	—	—	—	—	3 min	4 min	4 min	M
	b) Fire extinction time ²⁾ , <i>Max</i>	—	—	—	—	—	5 min	6 min	6 min	M
	(Total Foam discharge / application time)									
	c) Seal ability/Film forming	—	—	—	—	—	To pass the test	To pass the test	To pass the test	M
	d) Burn back, <i>Min</i>	—	—	—	—	—	5 min	8 min	8 min	M

¹⁾ Fire control time defined as 90 percent control of fire by visual examination.
²⁾ Fire extinction time defined as 100 percent fire is extinguished.

ANNEX A

(Table 1)

**METHOD FOR VISUAL EXAMINATION AND AGEING/CONDITIONING
OF FOAM CONCENTRATE SOLUTION****A-1 VISUAL EXAMINATION**

Foam liquid concentrate (500 ml) shall be conditioned at $27 \pm 5^\circ\text{C}$ for 6 h taking in glass beaker, after proper stirring and shaking the container in which foam liquid concentrate is stored.

following cycle of conditioning:

<i>Temperature</i>	<i>Period</i>
At (+) 60°C	24 h
Ambient temperature	2 h
At $0^\circ\text{C}^{1)}$	24 h

¹⁾ (-20°C) for freeze protected foam.

**A-2 AGEING/CONDITIONING OF FOAM
CONCENTRATE SOLUTION**

Shake/roll the container in which the foam concentrate is stored after keeping upside down for 10 min till the sediment completely disperses in the foam container and then take 1/0.5 litre of foam concentrate solution in a glass bottle or in an appropriate polythene container with closing the opening mouth. Now complete the

For regular batch at least one cycle is to be performed. But for type test having same formulation once in a year each cycle is to be counted for every 2 years of shelf life (storage), that is, if shelf life of foam concentrate is 10 years, conditioning cycle will be 5 years. The concentrate also shall not show any sedimentation/stratification on physical observation.

ANNEX B

(Table 1)

METHOD FOR THE DETERMINATION OF *pH* VALUE**B-1 PROCEDURE**

B-1.1 Take about 100 ml of a thoroughly mixed original that is unconditioned sample of foam concentrate in a beaker and measure its *pH* value on a standard *pH* electrometer (see IS 4309) using glass electrode at a

temperature of $27 \pm 5^\circ\text{C}$. Record the *pH* value to the nearest 0.01.

B-1.2 Repeat the experiment as in **B-1.1** by taking about 100 ml of conditioned sample taken from **A-2** and record the *pH* value to the nearest 0.01.

ANNEX C

(Table 1)

METHOD FOR THE DETERMINATION OF SPECIFIC GRAVITY**C-1 PROCEDURE**

C-1.1 Determine the specific gravity of 100 ml of the thoroughly mixed unconditioned sample of foam concentrate of each type at a temperature of $27 \pm 5^\circ\text{C}$ using a calibrated hydrometer or specific gravity bottle.

C-1.2 Determine the specific gravity of the 100 ml conditioned sample taken from **A-2** in the same manner as in **C-1.1**.

C-1.3 Record the results to the nearest 0.01.

ANNEX D

(Table 1)

METHOD FOR THE DETERMINATION OF MISCIBILITY WITH
DISTILLED WATER AND SYNTHETIC SEA WATER

D-1 PREPARATION OF SYNTHETIC SEA WATER

Prepare synthetic sea water by dissolving the following salts in 1 litre of distilled water:

<i>Salt</i>	<i>Content, Percent</i>
Sodium chloride (NaCl)	2.50
Magnesium chloride ($\text{MgCl}_2 \cdot 6\text{H}_2\text{O}$)	1.10
Sodium sulphate (Na_2SO_4)	0.40
Calcium chloride ($\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$) dihydrate	0.16
Distilled water	95.84

D-2 PREPARATION OF SAMPLE

D-2.1 Prepare a solution of 250 ml containing 6 percent of Type 3 foam concentrate in both distilled water and synthetic sea water as prepared in **D-1.1** by volume at a temperature of $27 \pm 5^\circ\text{C}$ (Mix separately 15 ml

concentrated solution with 235 ml distilled water and 235 ml synthetic sea water).

D-2.2 Prepare a solution of 250 ml containing 12 percent of Type 6 foam concentrate in both distilled water and synthetic sea water as prepared in **D-1.1** by volume at a temperature of $27 \pm 5^\circ\text{C}$ (Mix separately 30 ml concentrated solution with 220 ml distilled water and 220 ml synthetic sea water).

D-2.3 Prepare a solution of 250 ml containing 2 percent of Type 1 foam concentrate in both distilled water and synthetic sea water as prepared in **D-1.1** by volume at a temperature of $27 \pm 5^\circ\text{C}$ (Mix separately 5 ml concentrated solution with 245 ml distilled water and 245 ml synthetic sea water).

D-3 PROCEDURE

D-3.1 The solutions as prepared in **D-2.1**, **D-2.2** and **D-2.3** shall be kept separately in stoppered graduated cylinder for 24 h. The solutions shall not show any stratification, precipitation and turbidity when examined visually at a temperature of $27 \pm 5^\circ\text{C}$.

ANNEX E

(Table 1)

METHOD FOR THE DETERMINATION OF POUR POINT

E-1 APPARATUS

The apparatus shall be as shown in Fig. 1 and shall consist the following:

- Test jar** — A test jar of clear glass, cylindrical form, flat bottom, approximately 30 to 35 mm inside diameter and 112 to 125 mm in height. An ordinary 100 ml sample bottle may be used, if it meets these requirements.
- Thermometer** — A cloud and pour test thermometer which can read down to $-5^\circ\text{C}/-25^\circ\text{C}$ /digital thermometer as pre-requirement having sensor rod fitted with control panel with wire.
- Cork** — To fit the test jar, bored centrally to take the test thermometer.
- Jacket** — A jacket of glass or metal, water-tight, of cylindrical form, flat bottom about 112 mm in depth with inside diameter 10 to 12 mm greater than the outside diameter of the test jar.

e) **Disc** — A disc of cork or felt, 6 mm thick and of the same diameter as the inside of the jacket.

f) **Gasket** — A gasket about 5 mm thick, to fit snugly around the outside of the test jar and loosely inside the jacket. This gasket may be made of cork, felt or other suitable material, elastic enough to cling to the test jar and hard enough to hold its shape. The purpose of the ring gasket is to prevent the test jar from touching jacket.

g) **Bath** — A cooling bath of suitable size and shape to obtain the required temperatures. The bath shall be provided with a support, suitable for holding the jacket firmly in a vertical position. The required bath temperature may be mentioned by refrigeration, if available, otherwise by suitable freezing mixtures.

NOTE — Digital deep freeze having temperature indicator may be used instead of cooling bath.

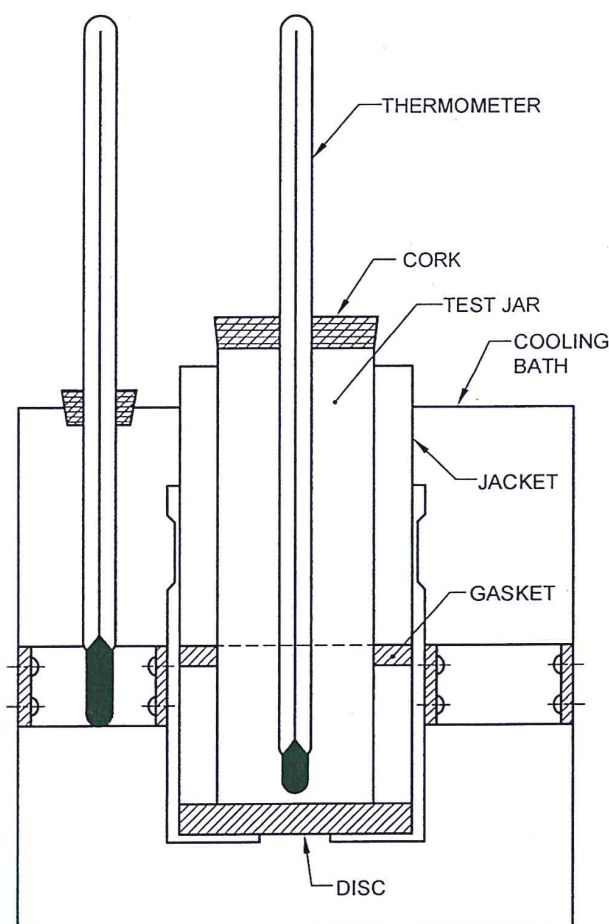


FIG. 1 APPARATUS FOR POUR POINT TEST

E-2 PROCEDURE

The following procedure shall be followed:

- Pour the thoroughly shaken sample of foam compound into the test jar to a height of not less than 50 mm and not more than 56 mm. Mark the jar to indicate the proper level.
- Close the test jar tightly by the cork carrying the test thermometer in a vertical position in the centre of the jar with the thermometer bulb immersed so that the beginning of the capillary shall be 3 mm below the surface of the sample.
- Fix the thermometer/sensor for digital thermometer in vertical position.
- Place the disc in the jacket and insert the test jar with the ring gasket 25 mm above the bottom into the gasket.
- Maintain the temperature of the cooling bath/deep freeze at -5°C for 0°C for foam concentrate and -25°C for sub-zero foam concentrate. Support the jacket containing the test jar, firmly in a vertical position in the cooling bath so that not more than 25 mm of the jacket projects out of the cooling medium. As soon as the temperature of the foam compound in the test jar goes down to 0°C , the jar shall be tilted and flow observed by holding the test jar in a horizontal position for 5 s as noted by stop-watch and foam compound shall flow freely.
- In case of deep freeze, keep the sample dipping the sensor of thermometer into the solution and control panel of the thermometer outside the deep freeze for observation.

ANNEX F

(Table 1)

METHOD FOR THE DETERMINATION OF SLUDGE CONTENT

F-1 PREPARATION

F-1.1 Shake/roll the container in which the foam concentrate is stored after keeping upside down for 10 min till the sediment completely disperses in the liquid and then draw original sample A as described below.

- | | |
|-----------------------------|---|
| <i>Original Sample A</i> | – 50/100 ml to be drawn in 50/100 ml cone shaped graduated clear glass centrifuge tube. |
| <i>Conditioned Sample B</i> | – 50/100 ml to be drawn in 50/100 ml cone shaped graduated clear glass centrifuge tube from the conditioned sample (see A-2) after shaking/rolling. |

F-1.2 Take 100/50 ml original and conditioned sample as described above and allow it to attain temperature of $27 \pm 5^{\circ}\text{C}$. Shake well by rotation till any sediment which may have settled has dispersed uniformly and pour into 100/50 centrifuge tube.

F-2 PROCEDURE

Centrifuge the Sample A and Sample B for 10 min immediately after drawing the sample at least minimum speed of 2 000 rpm. Pour out the liquid gently after centrifuging. Dry the centrifuge tube containing the sludge in an oven at 80°C for 1 h. Then keep it at ambient temperature for 30 min in a desiccator having concentrated sulphuric acid (H_2SO_4)/suitable drying agent and take the weight of centrifuge tube along with

sludge. Calculate the sludge content as follows:

$$\text{Sludge content, percent} = \frac{\text{Water of sludge content of the sample}}{\text{Volume of foam (50/100 ml)} \times \text{Specific gravity}} \times 100$$

ANNEX G

(Table 1)

DETERMINATION OF SURFACE TENSION, INTERFACIAL TENSION AND SPREADING COEFFICIENT

G-1 MATERIALS

G-1.1 Solution of foam concentrate, at the recommended concentration for use in freshly made distilled water complying having surface tension not less than 70 dyne/cm.

NOTE — The solution may be made up in a 100 ml volumetric flask using a pipette to measure the foam concentrate.

G-1.2 Cyclohexane, of purity not less than 99 percent (AR grade) for interfacial tension and spreading coefficient only.

G-2 SURFACE TENSION

Determine the surface tension of the solution at a temperature of $27 \pm 5^\circ\text{C}$ using the ring method.

G-2.1 Apparatus

The following apparatus are required:

- Du Nouy precision tensiometer,
- Platinum ring of 4 or 6 cm circumference, and
- Sample container (glass) 6 cm in diameter.

G-2.2 Sample

Prepare the foam concentrate solution with distilled water as follows:

- For Type 1* — 1 ml of foam concentrate + 99 ml of distilled water,
- For Type 3* — 3 ml of foam concentrate + 97 ml distilled water, and
- For Type 6* — 6 ml of foam concentrate + 94 ml distilled water.

G-2.3 Procedure

Calibrate the tensiometer, if applicable as per manufacturer's instruction. Clean the sample container with distilled water and rinse it with foam solution. Clean the platinum ring with distilled water and then dry it with non sooty flame (preferably with alcohol lamp).

Fix the dry platinum ring in the arm of tensiometer and set the platinum ring with the mark on the glass mirror in a single parallel line. Set the dial and vernier at zero.

Now pour about 50 ml of foam concentrate solution in to the sample container and keep it on the platform of the tensiometer. Now immerse the platinum ring in to the foam solution by raising the platform of the foam container. Wait for 1 min. Now raise the platinum ring by knob and down the platform slowly so that arm holding platinum ring remains same parallel line on the marked of the mirror. Do this process until the ring burst and come out from the solution. Record the reading of the dial. This may be apparent surface tension and actual surface tension may be determined by the formula provided by the manufacturer of tensiometer.

G-3 INTERFACIAL TENSION

After measuring the surface tension in accordance with **G-2.3**, make a layer of cyclohexane at $27 \pm 5^\circ\text{C}$ and the foam solution by pouring cyclohexane into the foam solution, being careful to avoid contact between the ring and the cyclohexane. Wait for 2 min and then measure the interfacial tension as under.

G-3.1 Apparatus

Same as in **G-2.1**.

G-3.2 Procedure

After recording the result of surface tension, again wash the platinum ring with distilled water and dry it on non sooty flame. Now fix the platinum ring in the arm of the tensiometer. Set the dial zero by keeping the ring parallel to the marked on the glass mirror. Now immerse the platinum ring into the foam solution by lifting the platform of the glass container having foam solution. Now pour sufficient amount of cyclohexane (about 50 ml) on the foam solution very slowly without any agitation. A clear visible layer between the juncture of foam liquid and cyclohexane is formed. Wait for 2 min. Now rise the platinum ring and down the platform of foam container keeping the holder arm of platinum ring is in parallel line with the mark on the glass mirror. Record the reading of the dial when the ring burst from the junction of the two layers of the two liquids. This may be apparent interfacial tension. Actual interfacial tension is calculated by the formula

provided by the manufacturer of tensiometer.

NOTES

- 1 Use fresh solutions and freshly cleaned platinum ring for each determination.
- 2 Always move the ring from the aqueous side of the interface through to the non-aqueous side liquid.
- 3 First place the aqueous solutions in the sample vessel and immerse the ring therein. Carefully pour the cyclohexane on top of the aqueous solution to form the two-layer systems. Contact between the oil and the platinum ring should be avoided during this operation. After allowing sufficient time, make the measurement in the same manner as that used for measuring surface tension.

G-4 SPREADING COEFFICIENT

Calculate the spreading coefficient between the solution and cyclohexane from the equation:

$$S = \gamma_c - \gamma_f - \gamma_i$$

where

- S = spreading coefficient, in dynes/cm;
 γ_c = surface tension of the cyclohexane, in dynes/cm;
 γ_f = surface tension of the foam solution, in dynes/cm; and
 γ_i = interfacial tension between the foam solution and cyclohexane, in dynes/cm.

G-5 DIGITAL TENSIO METER

Make sure that the digital tensiometer is calibrated. Introduce the solution of foam in to device. Ensure zero reading in the monitor, start operation as mentioned above and finally note the reading from the monitor in dynes/cm.

ANNEX H

(Clause 4.2)

METHOD OF GENERATING FOAM

H-1 FOAM MAKING NOZZLE

A foam making nozzle having a water discharge capacity of 7.5 ± 0.3 l/min at 7 ± 0.3 kgf/cm² for hydrocarbon fire test (non polar) and 11.4 ± 0.3 l/min at 6.5 ± 0.3 kgf/cm² for polar solvent fire test shall be used for producing foam and checking the performance requirement laid down in Table 2. The details and the dimensions of the nozzle are given in Fig. 2 and Fig. 3.

H-2 ARRANGEMENT FOR GENERATING FOAM

The following apparatus shall be used and assembled as shown in Fig. 4:

- a) *About 100 litre capacity pressure reservoir* — Made of stainless steel or mild steel sheet and tested to withstand an internal pressure of 25 kgf/cm². It shall have a filling orifice of not less than 150 mm diameter with an airtight cap and other arrangements as given in Fig. 3;

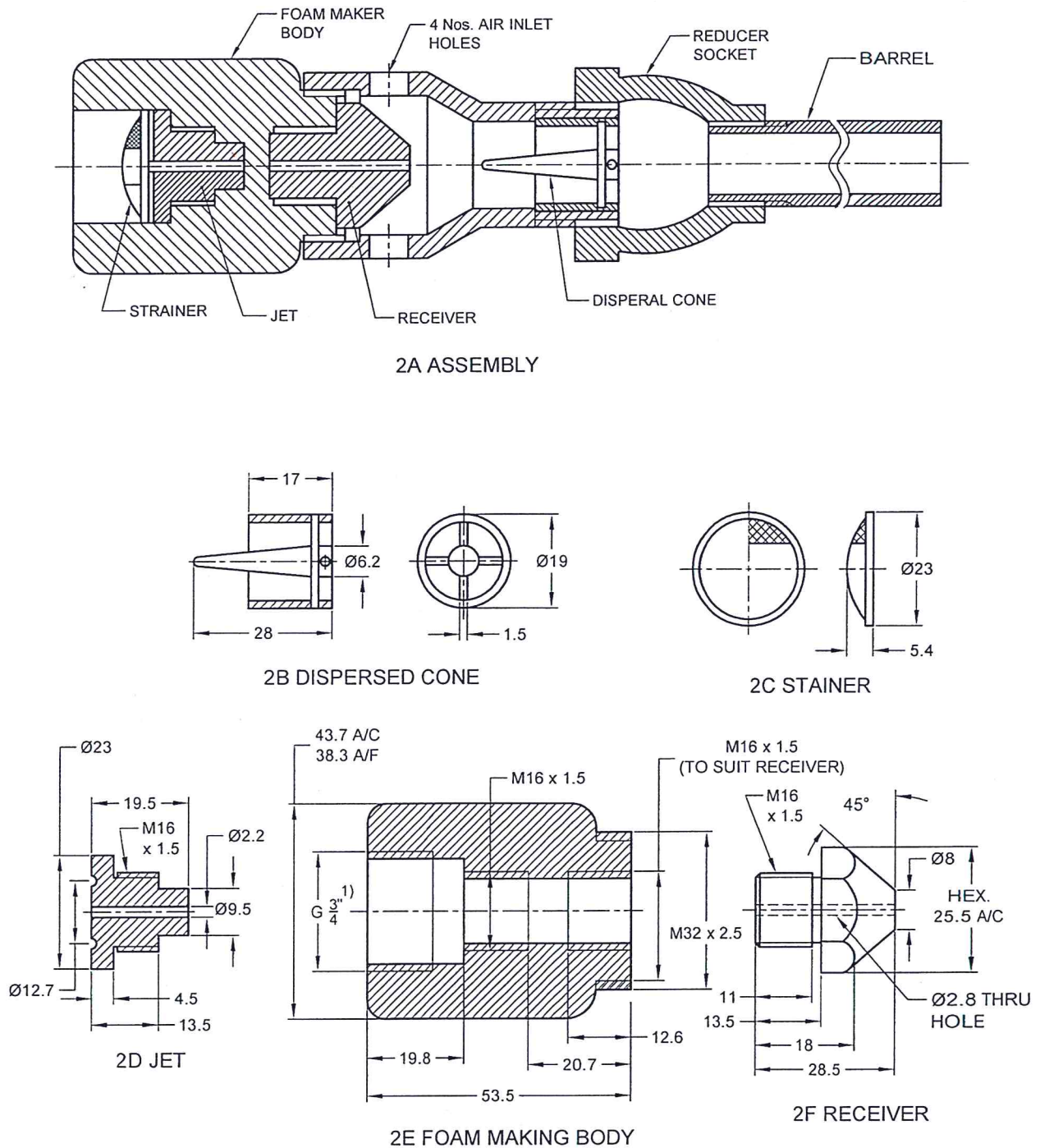
- b) Adjustable stand;
- c) Nozzle (*see* Fig. 2 and Fig. 3); and
- d) Air compressor.

H-3 CALIBRATION

The pressure gauges and nozzle shall be calibrated before use when new and thereafter at schedule interval according to the standard procedure.

H-4 FOAM GENERATION

The equipment shall be arranged as shown in Fig. 4. The reservoir should be filled with 90 litre of 3 percent or 6 percent premixed solution of foam compound and potable water in desired proportions. The cap shall be tightened. A pressure of 8 kgf/cm² shall be built up with help of air compressor. The discharge valve is then opened and the pressure is adjusted so as to give a pressure of 7 ± 0.3 kgf/cm² (6.5 ± 0.3 kgf/cm²) at the inlet of the nozzle.

FIG. 2 FOAM MAKING NOZZLE OF CAPACITY 7.5 ± 0.3 LITRE/MIN FOR HYDROCARBON FIRE TEST (NON POLAR) (CONTD)

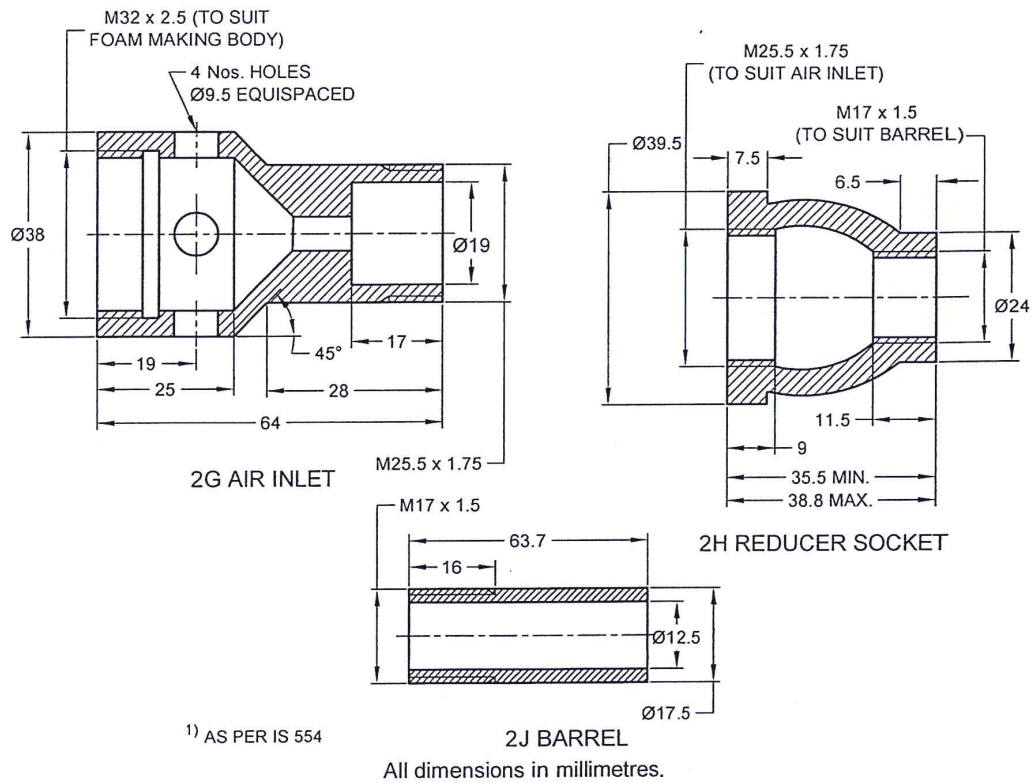


FIG. 2 FOAM MAKING NOZZLE OF CAPACITY 7.5 ± 0.3 LITRE /MIN FOR HYDROCARBON FIRE TEST (NON POLAR)

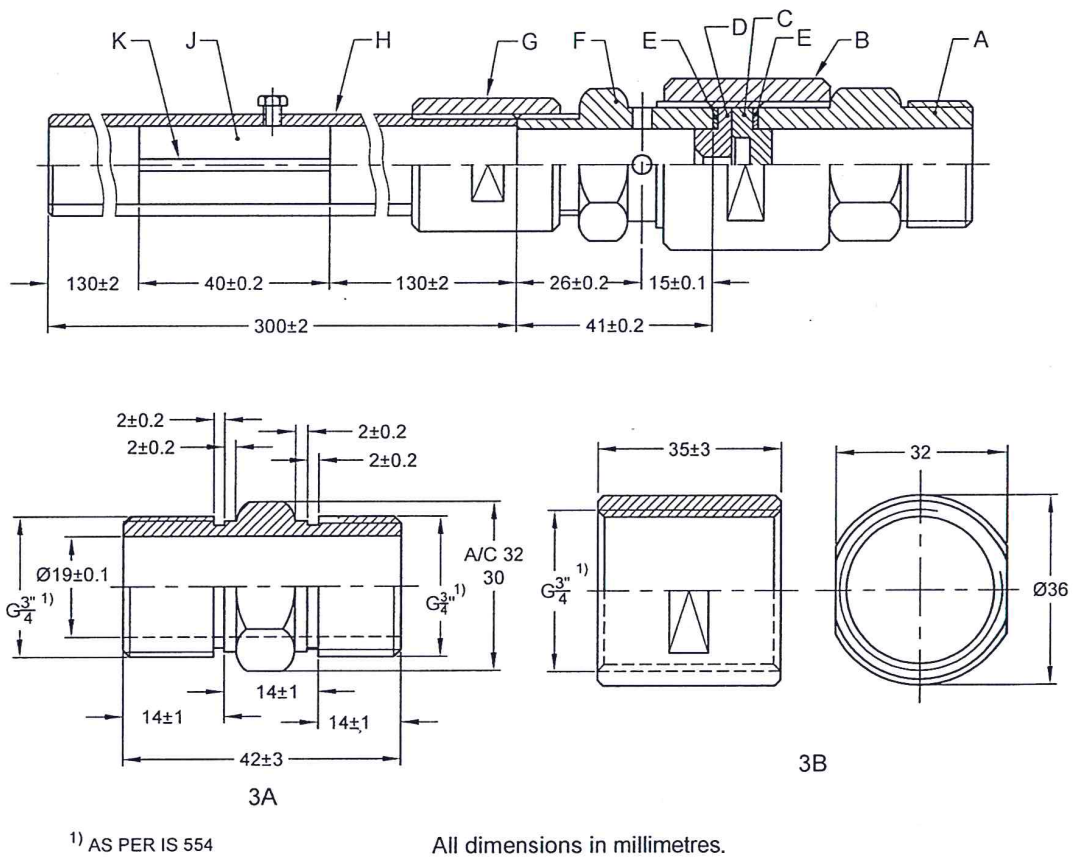
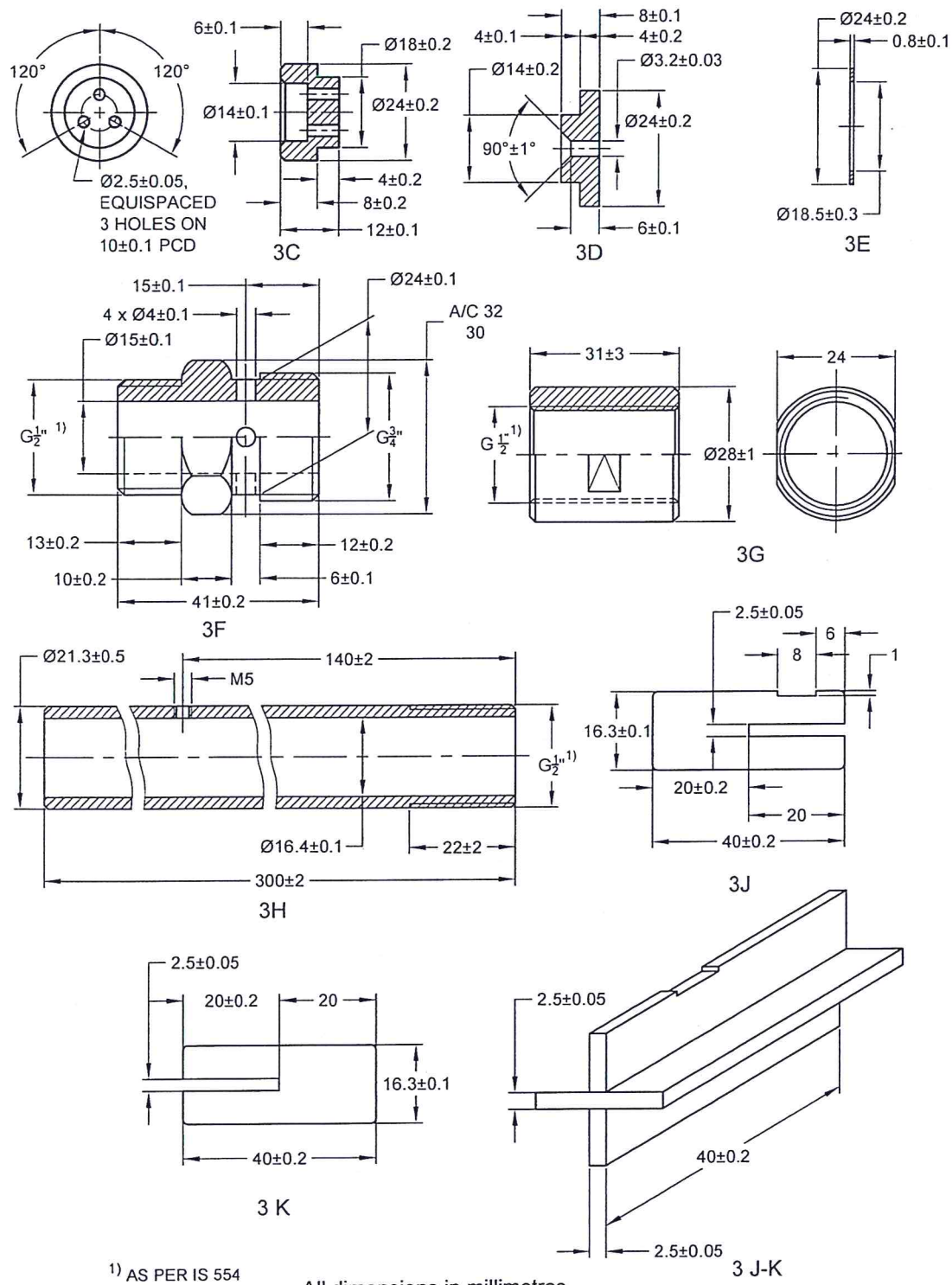


FIG. 3 FOAM MAKING NOZZLE OF CAPACITY 11.4 ± 0.3 LITRE /MIN FOR POLAR SOLVENT FIRE TEST (CONTD)

FIG. 3 FOAM MAKING NOZZLE OF CAPACITY 11.4 ± 0.3 LITRE /MIN FOR POLAR SOLVENT FIRE TEST

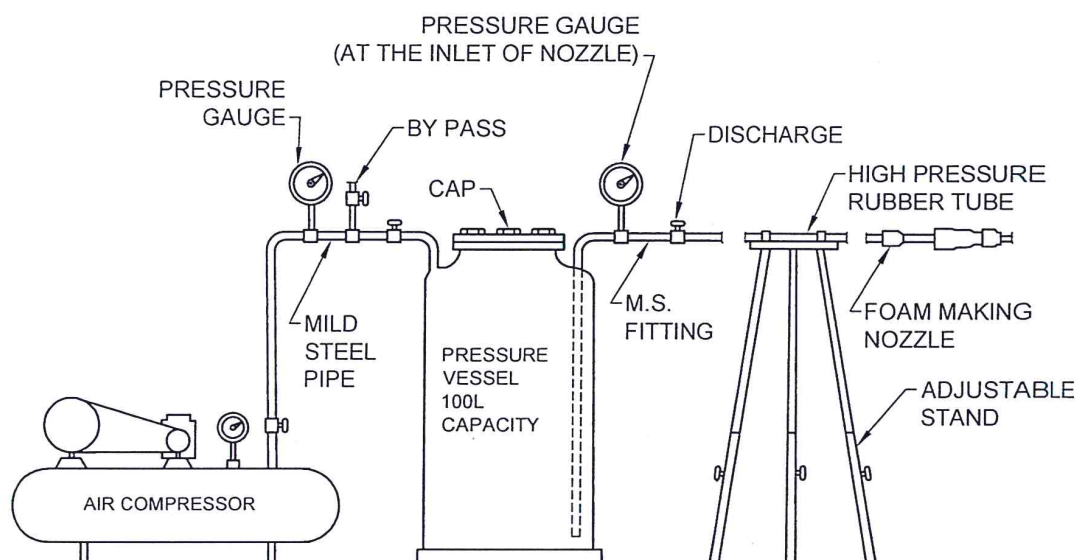


FIG. 4 ARRANGEMENT OF FOAM GENERATING EQUIPMENT

ANNEX J

(Table 2)

DETERMINATION OF EXPANSION AND DRAINAGE TIME

J-1 APPARATUS

J-1.1 Plastics or glass collecting vessel, of known volume of approximately 1600 ± 100 ml, equipped with a bottom discharge facility, as shown in Fig. 5.

J-1.2 Foam collector, for expansion and drainage measurement, as shown in Fig. 6. Stainless steel, aluminum, brass and plastics are suitable materials for the collection surface.

J-1.3 Foam-making nozzles (see Fig. 2 and Fig. 3), which when tested with water, has a flow rate of 7.5 ± 0.3 litre/min at a nozzle pressure of 7 ± 0.3 kgf/cm² or 11.4 ± 0.3 litre/min at a nozzle pressure of 6.5 ± 0.3 kgf/cm² as applicable.

J-1.4 Foam solution vessel, connected to the nozzle.

J-2 TEMPERATURE CONDITIONS

Carry out the tests under the temperatures of foam solution $27 \pm 5^\circ\text{C}$.

J-3 PROCEDURE FOR EXPANSION

Check that the pipework and hose from the foam solution tank to the nozzle is completely full of solution. Set up the nozzle horizontally, directly in front of the foam collector with the front of the nozzle about minimum

1 ± 0.3 m from the top edge of the collector. Wet the collecting vessel internally and weigh it (m_1). Set up the foam-making nozzle and adjust the nozzle pressure. Discharge foam and adjust the height of the nozzle so that the discharge strikes the collector centrally. Keep the nozzle horizontal. Stop foam discharge and rinse all the foam from the collector. Start discharging foam and, after 30 ± 5 s allowing to stabilize the discharge, place the collecting vessel with the discharge outlet closed, below the collector. Start stop watch when pan is half filled by foam and keep stop watch on until the 25 percent drainage time is achieved. Immediately after complete pouring foam into vessel, and as soon as the vessel is full, remove it from the collector, swipe off the foam surface level on the rim and also from the outer body of the foam collection vessel. Weigh the full vessel (m_2).

Calculate the expansion (E) from the equation:

$$E = \frac{V}{(m_2 - m_1)}$$

where

- V = volume of the collecting vessel, in litres;
- m_1 = mass of the empty vessel, in kg; and
- m_2 = mass of foam filled vessel, in kg.

J-4 PROCEDURE FOR CALCULATING 25 PERCENT DRAINAGE TIME

Immediately after the determination of foam expansion, 25 percent drainage volume should be calculated.

An example of calculating 25 percent drainage time is given below:

Volume of the drainage vessel : 1 600 ml
 Expansion of foam : 8
 25 percent drainage time volume = $1\,600 / (4 \times 8)$
 = 50 ml

- immediately after pouring foam into pan start the stop watch,
- measure expansion, and

- start noting of volume of drained water from 20 ml to 80 ml and prepare a graph time *versus* volume of drained liquid. Time in second for 50 ml drained liquid is the 25 percent drainage time in the above example.

Open the drainage valve and collect the foam solution in the 100 ml measuring cylinder to measure the 25 percent drainage time. Adjust the drainage facility such that the drained foam solution may flow out whilst preventing the passage of foam.

This may be achieved by controlling the level of the liquid/foam interface in the plastic tube at the outlet. As soon as drainage volume is achieved, stop the stop watch and record the time which is 25 percent drainage time.

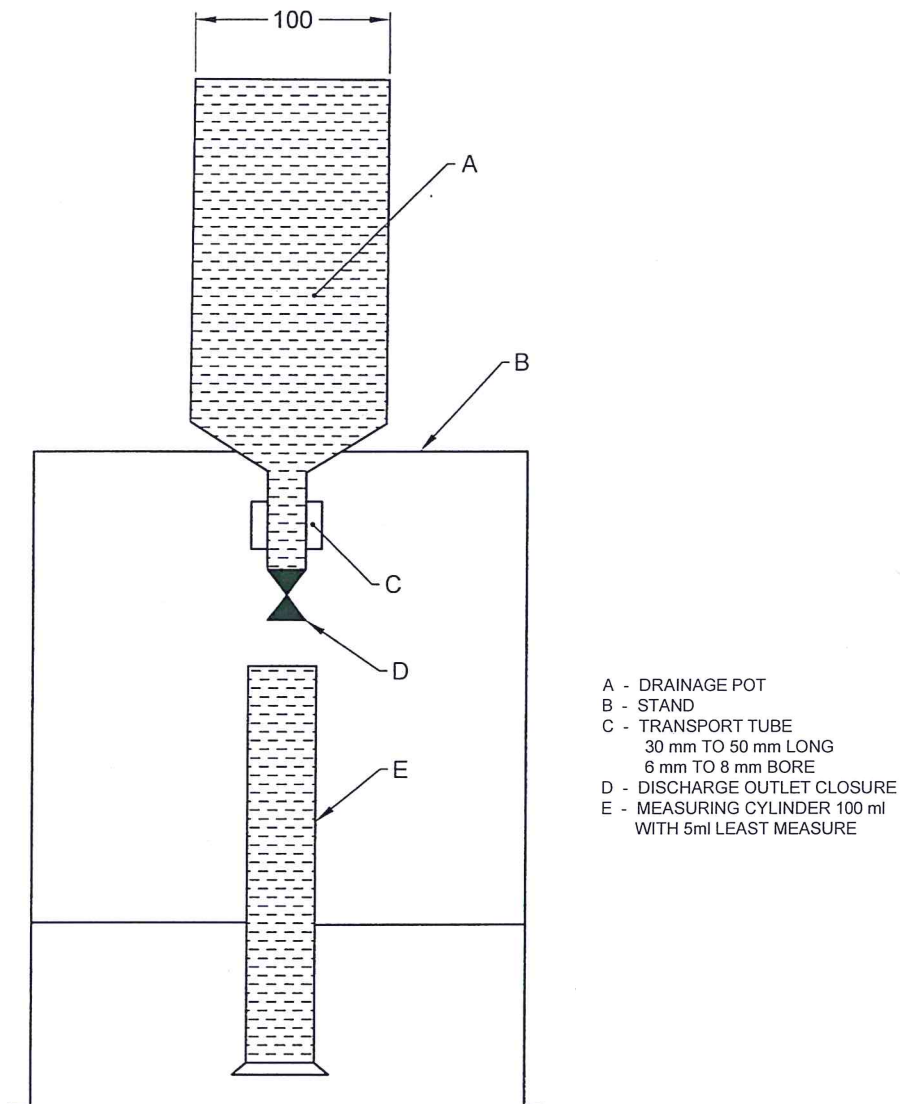
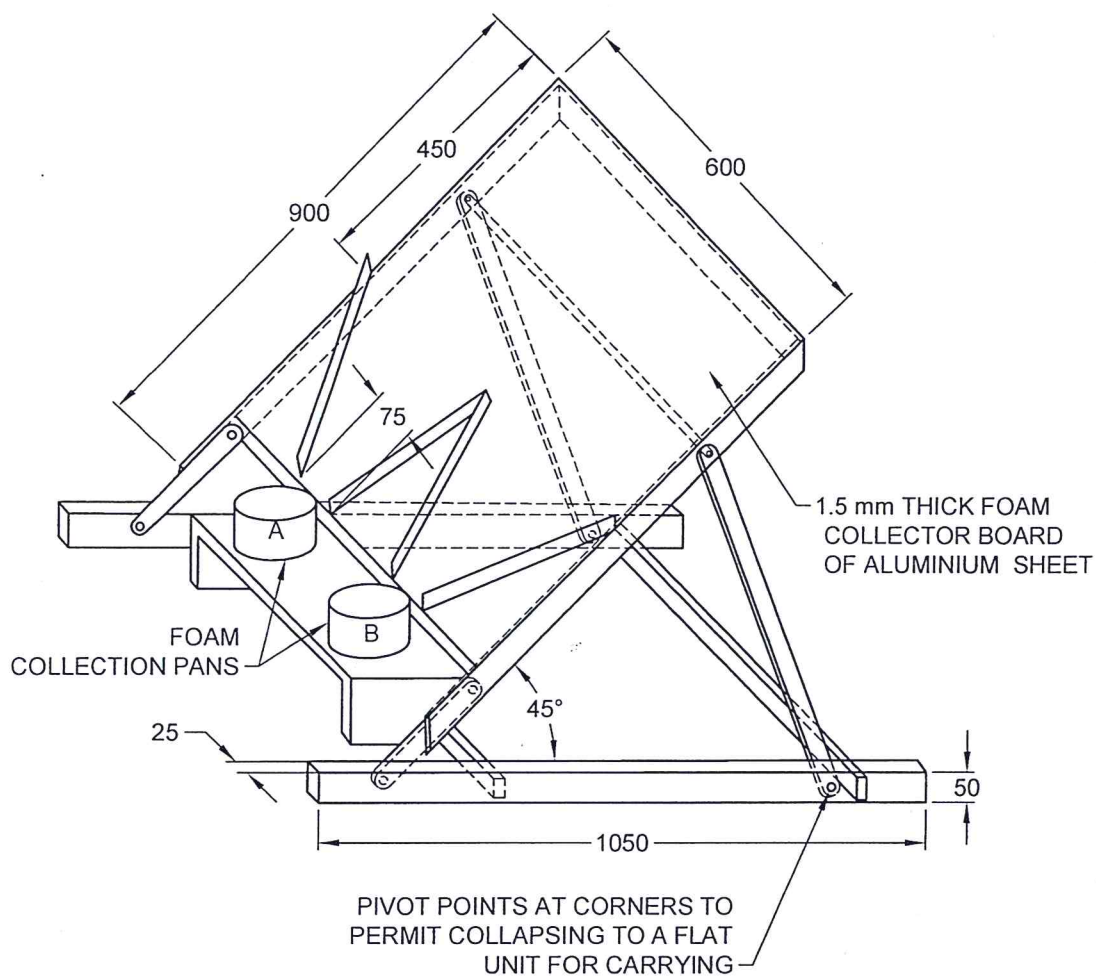


FIG. 5 COLLECTING VESSEL FOR DETERMINATION OF EXPANSION AND DRAINAGE TIME
 (CAPACITY – 1 600 ± 100 ML)



All dimensions are in millimetres.

FIG. 6 FOAM COLLECTOR

ANNEX K

(Table 2)

DETERMINATION OF FIRE PERFORMANCE TEST ON HYDROCARBON FUEL

K-1 GENERAL CONDITIONS

A test is successful only, if the appropriate requirements of this clause are met as per Table 2.

Carry out one test with potable water and the other with the synthetic sea water. If first test is not successful, repeat that test. If this repeat test is successful, then test is acceptable and no third test is required. No repeat test is required, if first test is successful.

K-2 TEMPERATURE AND WIND SPEED

Carry out the tests under the following conditions:

- a) Ambient temperature : 15°C to 40°C
- b) Maximum wind speed : 3 m/s in the proximity of the test pan

NOTE — If necessary, some form of wind-screen may be used.

K-3 RECORDS

During the first test, record the following:

- Indoor or outdoor test;
- Water type, potable/synthetic sea water and temperature of the solution;
- Ambient temperature;
- Wind speed;
- Control time;
- Extinction time;
- Seal-ability test result; and
- 25 percent burn back time.

K-4 FOAM SOLUTION

Prepare a foam solution with potable/synthetic sea water as per type of foam that is, 1 percent, 3 percent or 6 percent.

Use potable water to prepare the foam solution and also make a foam solution using simulated sea water made up by dissolving the components as per synthetic sea water composition given in this standard.

Fill up the solution in the foam tank, 100 litre capacity and arrange equipment as given in Fig. 4.

K-5 FUEL

115 litre of *n*-heptane as specified in 7.1.

K-6 EQUIPMENT

- Circular steel tray having inside diameter 2400 ± 25 mm and depth 200 ± 10 mm, made with minimum 2.5 mm thick steel sheet. Total base area is 4.52 m^2 .
- Adjustable stand to hold the nozzle firmly having design to easily removal the nozzle from the stand.
- Stop watch.
- Torch to ignite *n*-heptane and also to perform seal-ability test.
- Burn back pot, made of steel with nominal thickness 1.5 mm, diameter 300 ± 10 mm and depth 250 ± 10 mm.

K-7 FOAM APPLICATION

The foam making nozzle (7.5 ± 0.3 litre/min) is to be positioned above the test pan, fixed in a position by mechanical means for easy removal. Foam should be discharged directly on to the burning fuel surface with minimum agitation of fuel surface until the control of fire is attained. After attaining the control of fire, foam application may be started manually and may be directed on to the fuel surface moving all sides of the

fire pan as the discretion of fire operator to achieve the best result.

K-8 Preburn time of 60 ± 5 s when tested at ambient temperature between 15°C and 40°C .

K-9 PROCEDURE

Pour 100 litre of potable water in the tray. Pour 115 litre of *n*-heptane within 60 ± 5 s into the tank over the water surface of the tank so that the height of the fuel in tank is about 25 mm on the water surface. Position the test nozzle at such a level and direction that the foam stream, when discharged strikes above the fuel surface with minimum agitation of fuel surface. Nozzle end should not extend over any part of the test pan.

Ignite the *n*-heptane within 30 s of pouring and allow it to burn as per ambient temperature, mentioned in **K-8**. Generate foam and direct the stream in to the tank above the fuel surface for a period as per Table 2, Sl No.(iii)(b). Record the time of fire control and complete extinction.

NOTES

- Premix solution under pressure should be used within 45 min.
- Before fire test the fire tank should be cleaned properly free from rust and without any projection or dents.
- Potable water should be used in the fire pan.
- The technical persons performing this test should have to be protected with fire proof suits, shoes, gloves and helmet with face shield.

K-10 SEALABILITY TEST/FILM FORMING TEST

After 5 min of foam application a burning torch (flame height minimum 100 mm) is spread over on the foam surface of about 50 mm to 75 mm height covering edges and cross diagonal through the centre of the tray for a total period of about 60 s. Foam should not catch fire. Avoid touching of foam and dropping of fuel.

K-11 BURN BACK TEST

- Immediately (within 30 s) after completion of seal-ability test place burn back pot filled with *n*-heptane (three-fourth) at centre of tank.
- Ignite the pot with the help of a lighted torch.
- Record the time of 25 percent (approximate) spread of fire by visual observation.

NOTE — Allow the fuel to burn in draught free still air condition and ensure that flames are vertical. Watch by visual observation 25 percent of the fire test tank is under fire. This time is recorded as burn back time for a foam blanket which is an indirect measure of thermal stability as well as scalability of the foam blanket.

ANNEX M

(Table 2)

FIRE PERFORMANCE TEST ON POLAR SOLVENT FUEL
(FOR ALCOHOL RESISTANT FOAM CONCENTRATE)

M-1 GENERAL CONDITIONS

A test is successful only, if the appropriate requirements of this clause are met as per Table 2. Carry out one test with premix solution of foam concentrate of potable water and the other with the synthetic sea water. If first test is not successful, repeat that test. If this repeat test is successful, then test is acceptable and no third test is required. No repeat test is required, if first test is successful.

M-2 TEMPERATURE AND WIND SPEED

Carry out the tests under the following conditions:

- a) Ambient temperature : 15°C to 40°C
- b) Maximum wind speed : 3 m/s in the proximity of the test pan

NOTE — If necessary, some form of wind-screen may be used.

M-3 RECORDS

During the first test, record the following:

- a) Indoor or outdoor test,
- b) Water type that is potable water/ synthetic sea water and temperature,
- c) Ambient temperature,
- d) Wind speed,
- e) Control time (90 percent fire out visual),
- f) Extinction time,
- g) Sealability test result, and
- h) 25 percent burn back time.

M-4 FOAM SOLUTION

Prepare a foam solution with potable/synthetic sea water as per type of foam that is, 3 percent/3 percent and 3 percent/6 percent.

Use potable water to prepare up the foam solution and also make a foam solution using simulated sea water made up by dissolving the components as per synthetic sea water composition given in this standard.

Fill up the solution in the foam tank, 100 litre capacity and arrange equipment as given in Fig. 4.

M-5 FUEL

125 litre of iso-propyl alcohol as specified in 7.2.

M-6 FOAM APPLICATION

The foam making nozzle (11.4 ± 0.3 l/min) is to be positioned above the test pan, fixed horizontally in a

position so that the foam should be discharged on to the back board above the water fuel surface about 0.5 m.

M-7 EQUIPMENT

- a) Circular steel tray having inside diameter 1480 ± 15 mm and depth 150 ± 10 mm, made with minimum 2.5 mm thick steel sheet. Total base area is 1.73 m^2 .
- b) Adjustable stand to hold the nozzle firmly.
- c) Stop watch.
- d) Torch to ignite *n*-heptane and also to perform sealability test.
- e) Burn back pot, made of steel with nominal thickness 1.5 mm, diameter 300 ± 10 mm and depth 250 ± 10 mm.
- f) *Adjustable back board* — A back board of width and height of 1 000 mm having design to fix and remove the back board with fire tray easily with suitable means.

M-8 Preburn time of 60 ± 5 s when tested at ambient temperature between 15°C and 40 °C.

M-9 PROCEDURE

Pour 125 litre of iso-propyl alcohol into the fire tray. Position the test nozzle at 7 kgf/cm² pressure at such a level and direction that the foam stream, when discharged strikes it on the back board as per K-6. Nozzle end should not extend over any part of the test pan. There should be no gap more than 60 s between pouring and igniting the fuel for fire test.

Ignite the iso-propyl alcohol within 30 s of pouring and allow it to burn as per ambient temperature, mentioned in M-8. Generate foam and direct the stream into the back board at about 0.5 m from the fuel surface for a duration of time as per Table 2, Sl No. (iv)(b). Record the time of fire control and complete extinction.

NOTES

- 1 Premix solution under pressure should be used within 45 min.
- 2 Before fire test the fire tank should be cleaned properly free from rust and without any projection or dents.
- 3 The technical persons performing this test should have to be protected with fire proof suits, shoes, gloves and helmet with face shield.

M-10 SEALABILITY TEST

After 5 min of foam application a burning torch (flame height minimum 100 mm) is spread over above the foam surface of about 50 mm to 75 mm height covering

edges and cross diagonal through the centre of the pan for a total period of about 60 s. Foam should not catch fire. Avoid touching of foam and dropping of fuel.

M-11 BURN BACK TEST

- Immediately (within 30 s) after completion of sealability test place burn back pot filled with *n*-heptane (three - fourth) at centre of tank.
- Ignite the pot with the help of a lighted torch.

- Record the time of 25 percent (approximate) spread of fire by visual observation.

NOTE — Allow the fuel to burn in draught free still air condition and ensure that flames are vertical. Watch by visual observation 25 percent of the fire test tank is under fire. This time is recorded as burn back time for a foam blanket which is an indirect measure of thermal stability as well as scalability of the foam blanket.

ANNEX N

(Foreword)

COMMITTEE COMPOSITION

Fire Fighting Sectional Committee, CED 22

<i>Organization</i>	<i>Representative(s)</i>
Ministry of Home Affairs, New Delhi	SHRI D. K. SHAMI (Chairman)
Agni Controls, Chennai	SHRI D. BALACHANDRAN
Airports Authority of India, New Delhi	SHRI SUBHASH KUMAR SHRI P. K. DESHMUKH (<i>Alternate</i>)
Bhabha Atomic Research Centre, Mumbai	CHIEF FIRE OFFICER
CSIR-Central Building Research Institute, Roorkee	DR R. S. CHIMOTE SHRI SUVIR SINGH (<i>Alternate</i>)
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Central Public Works Department, New Delhi	SHRI CHAITANYA KUMAR VERMA SHRI D. K. TULANI (<i>Alternate</i>)
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Chhatariya Rubber & Chemicals Industries, Mumbai	SHRI S. A. HAVELIWALA SHRI H. S. HAVELIWALA (<i>Alternate</i>)
Controllorate of Quality Assurance, Pune	COL V. V. KADAM COL N. K. N. RAO (<i>Alternate</i>)
Delhi Fire Services, New Delhi	SHRI A. K. SHARMA DR G. C. MISRA (<i>Alternate</i>)
Directorate of Fire and Emergency Services, Goa	SHRI ASHOK MENON SHRI RAJENDRA A. HALDANKAR (<i>Alternate</i>)
Military Engineer Services, Engineer-in-Chief's Branch, New Delhi	DR RAM VERMA SHRI V. K. GULATI (<i>Alternate</i>)
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F. M. Engineering International India Branch, Bengaluru	SHRI SUMIT KHANNA SHRI PRASAD KULKARNI (<i>Alternate</i>)
Fire & Emergency Services, J&K, Srinagar	DR G. A. BHAT

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Fire Protection Association of India, Mumbai	PRESIDENT
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Gunnebo India Pvt Limited, Chennai	SHRI K. ARUL PRAKASH SHRI RAJESH SHARMA (<i>Alternate</i>)
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Mumbai Fire Brigade, Mumbai	CHIEF FIRE OFFICER DEPUTY CHIEF FIRE OFFICER (<i>Alternate</i>)
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Reliance Industries Limited, Mumbai	SHRI VARADENDRA KOTI SHRI UMESH KHANDALKAR (<i>Alternate</i>)
RESQ Technologies, Ahmedabad	SHRI ROHIT V. SHAH
Safex Fire Services Limited, Mumbai	SHRI JITENDRA SHAH SHRI SANDIP SHAH (<i>Alternate</i>)
Shah Bhogilal Jethalal & Bros, Ahmedabad	SHRI MUKESH M. SHAH SHRI ABHAY D. PURANDARE (<i>Alternate</i>)
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UL India Pvt Limited, Bengaluru	SHRI JAGDISH V. SHRI S. P. TEJ KUMAR BEHARA (<i>Alternate</i>)
Uttar Pradesh Fire Services, Lucknow	SHRI P. K. RAO SHRI AMAN SHARMA (<i>Alternate</i>)
West Bengal Fire and Emergency Service, Kolkata	SHRI D. P. BISWAS SHRI G. K. BHATTACHARYA (<i>Alternate</i>)
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In personal capacity (A-45, Sector-70, Noida)	DR H. S. KAPRWAN
In personal capacity (A-347, Defence Colony, New Delhi)	SHRI R. C. SHARMA
In personal capacity (SJR Verity, VIVA-305, Amrita College Road, Bengaluru)	SHRI T. R. A. KRISHNAN
BIS Directorate General	SHRI SANJAY PANT, SCIENTIST 'F' AND HEAD (CIVIL ENGINEERING) [REPRESENTING DIRECTOR GENERAL (<i>Ex-officio</i>)]

Member Secretary
SHRI SRIKANTH YAJJALA
SCIENTIST 'C' (CIVIL ENGG), BIS

Fire Fighting Equipment Including Water Fittings Subcommittee, CED 22:2

<i>Organization</i>	<i>Representative(s)</i>
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ASKA Equipment Ltd, New Delhi	SHRI ASHOK H. GARG
Ceasefire Industries Limited, New Delhi	SHRI ASHUTOSH MANGAL
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Chhatriya Rubbers Chemicals Industries, Mumbai	SHRI S. A. HAVELIWALA SHRI H. S. HAVELIWALA (<i>Alternate</i>)
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Municipal Corporation of Greater Mumbai, Mumbai	CHIEF FIRE OFFICER DEPUTY CHIEF FIRE OFFICER (<i>Alternate</i>)
Newage Industries, Surendranagar	SHRI ASHOK M. SHAH

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Peter Autokits Pvt Limited, Mumbai	SHRI J. K. SHAH SHRI PARESH JOSHI (<i>Alternate</i>)
S & P Safety Products Pvt Limited, Kolkata	SHRI TUNIR CHAKRABARTI
Safex Fire Services Limited, Mumbai	SHRI JITENDRA SHAH SHRI SANDIP SHAH (<i>Alternate</i>)
Shah BhogilalJethalal& Bros, Ahmedabad	SHRI MUKESH M. SHAH SHRI ABHAY D. PURANDARE (<i>Alternate</i>)
Super Star Fire Tech Pvt Limited, Vadodara	SHRI ROHIT MEHTA SHRI TUSHAR MEHTA (<i>Alternate</i>)
Surex Production and Sales Private Limited, Kolkata	SHRI DEBASHIS NEOGI
Topaz Fire Systems Pvt Ltd, Bengaluru	SHRI LIAQUT ALI KHAN
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(Continued from second cover)

foam concentrates for top application to water-miscible liquids'. Following International practices a new formulation of AFFF Foam Concentrate of 1 percent has been included. New clause of marking AFFF, FFFP, FP and all AR types has been included to declare the percentage of fluorocarbon surfactant in the formulation.

Other types of foams such as medium expansion and high expansion foam (20 - 200 and 200 - 1 000 expansions) which are produced from the synthetic foam are excluded from this standard as the principle for foaming method of used and application in fire protection also differs appreciably.

The composition of the Committee responsible for formulation of the standard is given in Annex N.

For the purpose of deciding whether a particular requirement of this standard is complied with the final value observed or calculated, expressing the result of a test or analysis shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of specified value in this standard.

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